Direct Methanol Fuel Cells

Recent Advances in
Direct Methanol Fuel Cells
at Los Alamos National Laboratory

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Direct Methanol Fuel Cells

Outline

- ***Programs & Projects***
  - **DMFCs for Portable Power Sources *(DARPA)***
  - **DMFCs for Potential Transportation Applications *(US DOE/OAAT)***
- ***Technical -- Cells and Short Stacks***
  - **POWER DENSITY**
  - **CROSSOVER AND FUEL UTILIZATION**
  - **COMMENTS ON ELECTROCATALYSIS**

Direct Methanol Fuel Cells

DMFCs for Portable Power Sources

LANL Activities

(1) DMFC Core Technology Developments

*Cell and stack component optimization

*Target maximized performance (power & efficiency) under the relevant operation conditions

(2) DMFC Stack technology

* Develop DMFC stack generating 50W net power at ambient air pressure, near 60^{o}C

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DMFCs for Portable Power Source

Recent Achievements

(1) MEA composition & fabrication optimized

(2) Optimized MEA & new DMFC hardware enable:

*300W/l of active volume at 1 atm, 60^{o}C

*5-cell stack tested successfully (1000 hrs)

*First introduction of 50W DMFC stack in 50W/150Wh system scheduled by end of '99

(* Completely passive DMFC of similar structure yielded recently 15 mW/cm^2 of MEA)

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DMFCs for Potential Transportation Applications

Objectives:

- **Develop DMFC materials, components and operation conditions to demonstrate the potential of DMFCs for transportation applications in terms of *power density, energy conversion efficiency and cost:***

  *** optimize anode catalyst for performance & lower cost;**

  ***Prove low fuel utilization can be resolved with membranes of good conductivity and optimized stack operation conditions;**

  *** Prove stability of all cell components in longer term operation**

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DMFCs for Potential Transportation Applications

Achievements

- **5-cell LANL stack reconfigured to operate at 100^{o}C , 30 psig air, generating 1 kW per liter of active stack volume**
- **Fuel utilization near 90% demonstrated in 5-cell DMFC stack near the expected design point of 0.50V**
- **This corresponds to overall conversion efficiency of 37%**
- **Catalyst requirements lowered to 5 g Pt kW^{-1} vs. about 2 g Pt kW^{-1} estimated for today's on-board reforming system**

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DMFCs for Potential Transportation Applications

Status

*In terms of *power density* and *energy conversion efficiency*, the DMFC (based on short stack results) is today comparable with an on-board methanol reforming system

(** Vehicle w. DMFC power system is considered ZEV)

* There is a remaining (*although smaller than perceived*) gap in precious metal catalyst requirements, with the DMFC requiring 5 g Pt kW^{-1} vs. about 2 g Pt kW^{-1} required today for an on-board reforming system

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DMFCs for Portable Power & Transportation Applications

Future Efforts

System Level Work with Presnt Technology:

Liquid feed DMFCs with "leaky membranes" need to be demonstrated at the *system level* with full resolution of efficiency and water management challenges

R&D:

Enhanced anode activity is key for elevating system efficiency over 37%. This can be achieved with either catalyst better than PtRu, strong improvement in anode catalyst layer structure and/or higher cell temperature

Less leaky membranes **are of interest provided they maintain protonic conductivity of 0.1 σ /cm**

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